ArevaEPRDCPEm Resource

From: WILLIFORD Dennis (AREVA) [Dennis.Williford@areva.com]
Sent: Thursday, December 15, 2011 1:49 PM
To: Tesfaye, Getachew
Cc: BENNETT Kathy (AREVA); DELANO Karen (AREVA); ROMINE Judy (AREVA); RYAN Tom (AREVA)
Subject: Response to U.S. EPR Design Certification Application RAI No. 505 (5902,5735,5869,5754,5803,5950,5744), FSAR Ch. 7, Supplement 6
Attachments: RAI 505 Supplement 6 Response - US EPR DC.pdf

Getachew,

On September 29, 2011, AREVA NP Inc. provided a schedule for technically correct and complete responses to the 34 questions in RAI 505. In Supplement 1 sent on October 27, 2011, and Supplement 2 sent on November 17, 2011, AREVA NP provided a revised schedule for technically correct and complete responses to 33 questions and a preliminary revised schedule for Question 07.01-33. AREVA NP provided Supplement 3 on November 22, 2011 to provide a final response to 4 questions. On December 9, 2011, AREVA NP provided Supplement 4 to revise the schedule for 7 questions. On December 14, 2011, AREVA NP provided Supplement 5 to revise the schedule for 5 questions.

The attached file, "RAI 505 Supplement 6 Response US EPR DC.pdf" provides technically correct and complete responses to 6 of the remaining 30 questions. Appended to this file are affected pages of the U.S. EPR Final Safety Analysis Report in redline-strikeout format which support the responses. Also appended to this file are affected pages of Technical Reports ANP-10304 and ANP-10309P. Revisions to these Technical Reports will be submitted by separate letter after completion of all responses to RAI 505.

The following table indicates the respective pages in the response document, "RAI 505 Supplement 6 Response US EPR DC.pdf," that contain AREVA NP's response to the subject questions.

Question #	Start Page	End Page
RAI 505 — 07.03-37	2	3
RAI 505 — 07.04-15	4	5
RAI 505 — 07.05-11	6	6
RAI 505 — 07.08-43	7	8
RAI 505 — 07.08-45	9	10
RAI 505 — 07.08-49	11	12

The schedule for a technically correct and complete response to the remaining 24 questions remains unchanged. The preliminary schedule for the response to Question 07.01-33 is being reevaluated and a new supplement with a revised schedule will be transmitted by January 25, 2012.

Question #	Response Date
RAI 505 — 07.01-33	January 25, 2012
RAI 505 — 07.01-34	January 10, 2012
RAI 505 — 07.01-35	February 9, 2012
RAI 505 — 07.01-36	January 10, 2012

RAI 505 — 07.01-37	January 19, 2012
RAI 505 — 07.01-38	January 10, 2012
RAI 505 — 07.01-39	January 10, 2012
RAI 505 — 07.01-40	January 10, 2012
RAI 505 — 07.01-41	January 10, 2012
RAI 505 — 07.01-42	January 10, 2012
RAI 505 — 07.01-44	January 10, 2012
RAI 505 — 07.01-45	February 9, 2012
RAI 505 — 07.01-46	February 9, 2012
RAI 505 — 07.01-47	January 10, 2012
RAI 505 — 07.01-48	January 10, 2012
RAI 505 — 07.01-49	January 10, 2012
RAI 505 — 07.01-50	January 10, 2012
RAI 505 — 07.01-51	January 10, 2012
RAI 505 — 07.03-38	February 9, 2012
RAI 505 — 07.05-10	January 19, 2012
RAI 505 — 07.08-44	January 10, 2012
RAI 505 — 07.08-47	January 10, 2012
RAI 505 — 07.08-48	January 10, 2012
RAI 505 — 07.09-71	January 10, 2012

Sincerely,

Dennis Williford, P.E.
U.S. EPR Design Certification Licensing Manager
AREVA NP Inc.
7207 IBM Drive, Mail Code CLT 2B
Charlotte, NC 28262
Phone: 704-805-2223
Email: Dennis.Williford@areva.com

From: WILLIFORD Dennis (RS/NB)
Sent: Wednesday, December 14, 2011 11:30 AM
To: Getachew.Tesfaye@nrc.gov
Cc: BENNETT Kathy (RS/NB); DELANO Karen (RS/NB); ROMINE Judy (RS/NB); RYAN Tom (RS/NB)
Subject: Response to U.S. EPR Design Certification Application RAI No. 505 (5902,5735,5869,5754,5803,5950,5744), FSAR Ch. 7, Supplement 5

Getachew,

On September 29, 2011, AREVA NP Inc. provided a schedule for technically correct and complete responses to the 34 questions in RAI 505. In Supplement 1 sent on October 27, 2011, and Supplement 2 sent on November 17, 2011, AREVA NP provided a revised schedule for technically correct and complete responses to 33 questions and a preliminary revised schedule for Question 07.01-33. AREVA NP provided Supplement 3 on November 22, 2011 to provide a final response to 4 questions. On December 9, 2011, AREVA NP provided a revised schedule for 7 questions.

The schedule for the response to four questions (Questions 7.1-35, 7.1-45, 7.1-46, and 7.3-38) is being changed, as indicated in bold below. In addition, the preliminary schedule for the response to Question 07.01-33 has been revised as indicated. This schedule is being reevaluated and a new supplement with a revised schedule will be transmitted by January 25, 2012. The schedule for a technically correct and complete response to the remaining 25 questions remains unchanged.

Question #	Response Date
RAI 505 — 07.01-33	**January 25, 2012**
RAI 505 — 07.01-34	January 10, 2012
RAI 505 — 07.01-35	**February 9, 2012**
RAI 505 — 07.01-36	January 10, 2012
RAI 505 — 07.01-37	January 19, 2012
RAI 505 — 07.01-38	January 10, 2012
RAI 505 — 07.01-39	January 10, 2012
RAI 505 — 07.01-40	January 10, 2012
RAI 505 — 07.01-41	January 10, 2012
RAI 505 — 07.01-42	January 10, 2012
RAI 505 — 07.01-44	January 10, 2012
RAI 505 — 07.01-45	**February 9, 2012**
RAI 505 — 07.01-46	**February 9, 2012**
RAI 505 — 07.01-47	January 10, 2012
RAI 505 — 07.01-48	January 10, 2012
RAI 505 — 07.01-49	January 10, 2012
RAI 505 — 07.01-50	January 10, 2012
RAI 505 — 07.01-51	January 10, 2012
RAI 505 — 07.03-37	January 19, 2012
RAI 505 — 07.03-38	**February 9, 2012**
RAI 505 — 07.04-15	January 19, 2012
RAI 505 — 07.05-10	January 19, 2012
RAI 505 — 07.05-11	January 19, 2012
RAI 505 — 07.08-43	January 19, 2012
RAI 505 — 07.08-44	January 10, 2012
RAI 505 — 07.08-45	January 10, 2012
RAI 505 — 07.08-47	January 10, 2012
RAI 505 — 07.08-48	January 10, 2012
RAI 505 — 07.08-49	January 19, 2012
RAI 505 — 07.09-71	January 10, 2012

Sincerely,

Dennis Williford, P.E.
U.S. EPR Design Certification Licensing Manager
AREVA NP Inc.
7207 IBM Drive, Mail Code CLT 2B
Charlotte, NC 28262

Phone: 704-805-2223
Email: Dennis.Williford@areva.com

From: RYAN Tom (RS/NB)
Sent: Friday, December 09, 2011 8:35 AM
To: Getachew.Tesfaye@nrc.gov
Cc: BENNETT Kathy (RS/NB); DELANO Karen (RS/NB); ROMINE Judy (RS/NB); RYAN Tom (RS/NB); WILLIFORD Dennis (RS/NB)
Subject: Response to U.S. EPR Design Certification Application RAI No. 505 (5902,5735,5869,5754,5803,5950,5744), FSAR Ch. 7, Supplement 4

Getachew,

On September 29, 2011, AREVA NP Inc. provided a schedule for technically correct and complete responses to the 34 questions in RAI 505. On October 27, 2011, and November 17, 2011, AREVA NP provided a revised schedule for technically correct and complete responses to 33 questions and a preliminary revised schedule for Question 07.01-33. On November 22, 2011, AREVA NP provided a final response to four questions.

The schedule for the response to the questions 7.1-37, 7.3-37, 7.4-15, 7.5-10, 7.5-11, 7.8-43, and 7.8-49 is being changed and indicated in bold below, the remaining 23 questions remains unchanged, as indicated below. In addition, the preliminary schedule for a response to Question 07.01-33 remains unchanged. The schedule for Question 07.01-33 is being reevaluated and a new supplement with a revised schedule will be transmitted by December 14, 2011.

Question #	Response Date
RAI 505 — 07.01-33	December 14, 2011
RAI 505 — 07.01-34	January 10, 2012
RAI 505 — 07.01-35	January 10, 2012
RAI 505 — 07.01-36	January 10, 2012
RAI 505 — 07.01-37	**January 19, 2012**
RAI 505 — 07.01-38	January 10, 2012
RAI 505 — 07.01-39	January 10, 2012
RAI 505 — 07.01-40	January 10, 2012
RAI 505 — 07.01-41	January 10, 2012
RAI 505 — 07.01-42	January 10, 2012
RAI 505 — 07.01-44	January 10, 2012
RAI 505 — 07.01-45	January 10, 2012
RAI 505 — 07.01-46	January 10, 2012
RAI 505 — 07.01-47	January 10, 2012
RAI 505 — 07.01-48	January 10, 2012
RAI 505 — 07.01-49	January 10, 2012
RAI 505 — 07.01-50	January 10, 2012
RAI 505 — 07.01-51	January 10, 2012
RAI 505 — 07.03-37	**January 19, 2012**
RAI 505 — 07.03-38	January 10, 2012
RAI 505 — 07.04-15	**January 19, 2012**
RAI 505 — 07.05-10	**January 19, 2012**

RAI 505 — 07.05-11	**January 19, 2012**
RAI 505 — 07.08-43	**January 19, 2012**
RAI 505 — 07.08-44	January 10, 2012
RAI 505 — 07.08-45	January 10, 2012
RAI 505 — 07.08-47	January 10, 2012
RAI 505 — 07.08-48	January 10, 2012
RAI 505 — 07.08-49	**January 19, 2012**
RAI 505 — 07.09-71	January 10, 2012

Sincerely,

Tom Ryan for
Dennis Williford, P.E.
U.S. EPR Design Certification Licensing Manager
AREVA NP Inc.
7207 IBM Drive, Mail Code CLT 2B
Charlotte, NC 28262
Phone: 704-805-2223
Email: Dennis.Williford@areva.com

From: WILLIFORD Dennis (RS/NB)
Sent: Tuesday, November 22, 2011 2:51 PM
To: Getachew.Tesfaye@nrc.gov
Cc: BENNETT Kathy (RS/NB); DELANO Karen (RS/NB); ROMINE Judy (RS/NB); RYAN Tom (RS/NB)
Subject: Response to U.S. EPR Design Certification Application RAI No. 505 (5902,5735,5869,5754,5803,5950,5744), FSAR Ch. 7, Supplement 3

Getachew,

On September 29, 2011, AREVA NP Inc. provided a schedule for technically correct and complete responses to the 34 questions in RAI 505. On October 27, 2011, and November 17, 2011, AREVA NP provided a revised schedule for technically correct and complete responses to 33 questions and a preliminary revised schedule for Question 07.01-33.

After discussions with NRC staff, the attached file, "RAI 505 Supplement 3 Response US EPR DC.pdf" provides technically correct and complete responses to 4 of the 34 questions. Appended to this file are affected pages of the U.S. EPR Final Safety Analysis Report in redline-strikeout format which support the responses to RAI 505 Question 07.07-23, Question 07.08 -46 and Question 07.09.02-72.

The following table indicates the respective pages in the response document, "RAI 505 Supplement 3 Response US EPR DC.pdf," that contain AREVA NP's response to the subject questions.

Question #	Start Page	End Page
RAI 505 — 07.01-43	2	3
RAI 505 — 07.07-23	4	4
RAI 505 — 07.08-46	5	5
RAI 505 — 07.09-72	6	7

The schedule for the response to the remaining 30 questions remains unchanged, as indicated below. In addition, the preliminary revised schedule for a response to Question 07.01-33 remains unchanged. The schedule for Question 07.01-33 is being reevaluated and a new supplement with a revised schedule will be transmitted by December 14, 2011.

Question #	Response Date
RAI 505 — 07.01-33	December 14, 2011
RAI 505 — 07.01-34	January 10, 2012
RAI 505 — 07.01-35	January 10, 2012
RAI 505 — 07.01-36	January 10, 2012
RAI 505 — 07.01-37	December 11, 2011
RAI 505 — 07.01-38	January 10, 2012
RAI 505 — 07.01-39	January 10, 2012
RAI 505 — 07.01-40	January 10, 2012
RAI 505 — 07.01-41	January 10, 2012
RAI 505 — 07.01-42	January 10, 2012
RAI 505 — 07.01-44	January 10, 2012
RAI 505 — 07.01-45	January 10, 2012
RAI 505 — 07.01-46	January 10, 2012
RAI 505 — 07.01-47	January 10, 2012
RAI 505 — 07.01-48	January 10, 2012
RAI 505 — 07.01-49	January 10, 2012
RAI 505 — 07.01-50	January 10, 2012
RAI 505 — 07.01-51	January 10, 2012
RAI 505 — 07.03-37	December 11, 2011
RAI 505 — 07.03-38	January 10, 2012
RAI 505 — 07.04-15	December 11, 2011
RAI 505 — 07.05-10	December 11, 2011
RAI 505 — 07.05-11	December 11, 2011
RAI 505 — 07.08-43	December 11, 2011
RAI 505 — 07.08-44	January 10, 2012
RAI 505 — 07.08-45	January 10, 2012
RAI 505 — 07.08-47	January 10, 2012
RAI 505 — 07.08-48	January 10, 2012
RAI 505 — 07.08-49	December 11, 2011
RAI 505 — 07.09-71	January 10, 2012

Sincerely,

Dennis Williford, P.E.
U.S. EPR Design Certification Licensing Manager
AREVA NP Inc.
7207 IBM Drive, Mail Code CLT 2B
Charlotte, NC 28262

Phone: 704-805-2223
Email: Dennis.Williford@areva.com

From: WILLIFORD Dennis (RS/NB)
Sent: Thursday, November 17, 2011 5:44 PM
To: Getachew.Tesfaye@nrc.gov
Cc: BENNETT Kathy (RS/NB); DELANO Karen (RS/NB); ROMINE Judy (RS/NB); RYAN Tom (RS/NB)
Subject: Response to U.S. EPR Design Certification Application RAI No. 505 (5902,5735,5869,5754,5803,5950,5744), FSAR Ch. 7, Supplement 2

Getachew,

On September 29, 2011, AREVA NP Inc. provided a schedule for technically correct and complete responses to the 34 questions in RAI 505. On October 27, 2011, AREVA NP provided a revised schedule for technically correct and complete responses to 13 questions and a preliminary revised schedule for Question 07.01-33.

The schedule for the final responses has been revised, as indicated in bold below. In addition, the preliminary revised schedule for a response to Question 07.01-33 has been revised. The schedule for Question 07.01-33 is being reevaluated and a new supplement with a revised schedule will be transmitted by December 14, 2011.

Question #	Response Date
RAI 505 — 07.01-33	**December 14, 2011**
RAI 505 — 07.01-34	**January 10, 2012**
RAI 505 — 07.01-35	**January 10, 2012**
RAI 505 — 07.01-36	**January 10, 2012**
RAI 505 — 07.01-37	**December 11, 2011**
RAI 505 — 07.01-38	January 10, 2012
RAI 505 — 07.01-39	**January 10, 2012**
RAI 505 — 07.01-40	**January 10, 2012**
RAI 505 — 07.01-41	**January 10, 2012**
RAI 505 — 07.01-42	**January 10, 2012**
RAI 505 — 07.01-43	**December 11, 2011**
RAI 505 — 07.01-44	January 10, 2012
RAI 505 — 07.01-45	January 10, 2012
RAI 505 — 07.01-46	January 10, 2012
RAI 505 — 07.01-47	January 10, 2012
RAI 505 — 07.01-48	January 10, 2012
RAI 505 — 07.01-49	January 10, 2012
RAI 505 — 07.01-50	January 10, 2012
RAI 505 — 07.01-51	January 10, 2012
RAI 505 — 07.03-37	**December 11, 2011**
RAI 505 — 07.03-38	January 10, 2012
RAI 505 — 07.04-15	**December 11, 2011**
RAI 505 — 07.05-10	**December 11, 2011**
RAI 505 — 07.05-11	**December 11, 2011**
RAI 505 — 07.07-23	**December 11, 2011**

RAI 505 — 07.08-43	**December 11, 2011**
RAI 505 — 07.08-44	**January 10, 2012**
RAI 505 — 07.08-45	**January 10, 2012**
RAI 505 — 07.08-46	**December 11, 2011**
RAI 505 — 07.08-47	January 10, 2012
RAI 505 — 07.08-48	January 10, 2012
RAI 505 — 07.08-49	**December 11, 2011**
RAI 505 — 07.09-71	**January 10, 2012**
RAI 505 — 07.09-72	**January 10, 2012**

Sincerely,

Dennis Williford, P.E.
U.S. EPR Design Certification Licensing Manager
AREVA NP Inc.
7207 IBM Drive, Mail Code CLT 2B
Charlotte, NC 28262
Phone: 704-805-2223
Email: Dennis.Williford@areva.com

From: WILLIFORD Dennis (RS/NB)
Sent: Thursday, October 27, 2011 11:22 AM
To: Getachew.Tesfaye@nrc.gov
Cc: BENNETT Kathy (RS/NB); DELANO Karen (RS/NB); ROMINE Judy (RS/NB); RYAN Tom (RS/NB)
Subject: Response to U.S. EPR Design Certification Application RAI No. 505 (5902,5735,5869,5754,5803,5950,5744), FSAR Ch. 7, Supplement 1

Getachew,

On September 29, 2011, AREVA NP Inc. provided a schedule for a technically correct and complete response to the 34 questions in RAI 505.

The schedule for the final response to Questions 07.01-38, 07.01-44, 07.01-45, 07.01-46, 07.01-47, 07.01-48, 07.01-49, 07.01-50, 07.01-51, 07.03-38, 07.08-43, 07.08-47, 07.08-48 has been revised, as indicated in bold below. In addition, a preliminary revised schedule for a technically correct and complete response to Question 07.01-33 is provided below. The schedule for Question 07.01-33 is being reevaluated and a new supplement with a revised schedule will be transmitted by November 17, 2011.

Question #	**Response Date**
RAI 505 — 07.01-33	**November 17, 2011**
RAI 505 — 07.01-34	December 8, 2011
RAI 505 — 07.01-35	November 17, 2011
RAI 505 — 07.01-36	December 8, 2011
RAI 505 — 07.01-37	December 8, 2011
RAI 505 — 07.01-38	**January 10, 2012**
RAI 505 — 07.01-39	December 8, 2011
RAI 505 — 07.01-40	December 8, 2011

RAI 505 — 07.01-41	November 17, 2011
RAI 505 — 07.01-42	December 20, 2011
RAI 505 — 07.01-43	November 17, 2011
RAI 505 — 07.01-44	**January 10, 2012**
RAI 505 — 07.01-45	**January 10, 2012**
RAI 505 — 07.01-46	**January 10, 2012**
RAI 505 — 07.01-47	**January 10, 2012**
RAI 505 — 07.01-48	**January 10, 2012**
RAI 505 — 07.01-49	**January 10, 2012**
RAI 505 — 07.01-50	**January 10, 2012**
RAI 505 — 07.01-51	**January 10, 2012**
RAI 505 — 07.03-37	November 17, 2011
RAI 505 — 07.03-38	**January 10, 2012**
RAI 505 — 07.04-15	November 17, 2011
RAI 505 — 07.05-10	November 17, 2011
RAI 505 — 07.05-11	November 17, 2011
RAI 505 — 07.07-23	November 17, 2011
RAI 505 — 07.08-43	**January 10, 2012**
RAI 505 — 07.08-44	December 8, 2011
RAI 505 — 07.08-45	December 8, 2011
RAI 505 — 07.08-46	December 8, 2011
RAI 505 — 07.08-47	**January 10, 2012**
RAI 505 — 07.08-48	**January 10, 2012**
RAI 505 — 07.08-49	November 17, 2011
RAI 505 — 07.09-71	December 8, 2011
RAI 505 — 07.09-72	December 8, 2011

Sincerely,

Dennis Williford, P.E.
U.S. EPR Design Certification Licensing Manager
AREVA NP Inc.
7207 IBM Drive, Mail Code CLT 2B
Charlotte, NC 28262
Phone: 704-805-2223
Email: Dennis.Williford@areva.com

From: WILLIFORD Dennis (RS/NB)
Sent: Thursday, September 29, 2011 11:04 AM
To: Getachew.Tesfaye@nrc.gov
Cc: BENNETT Kathy (RS/NB); DELANO Karen (RS/NB); ROMINE Judy (RS/NB); RYAN Tom (RS/NB)
Subject: Response to U.S. EPR Design Certification Application RAI No. 505 (5902,5735,5869,5754,5803,5950,5744), FSAR Ch. 7

Getachew,

Attached please find AREVA NP Inc.'s response to the subject request for additional information (RAI). The attached file, "RAI 505 Response US EPR DC.pdf," provides a schedule since a technically correct and complete response to the 34 questions cannot be provided at this time.

The following table indicates the respective pages in the response document, "RAI 505 Response US EPR DC.pdf," that contain AREVA NP's response to the subject questions.

Question #	Start Page	End Page
RAI 505 — 07.01-33	2	2
RAI 505 — 07.01-34	3	3
RAI 505 — 07.01-35	4	4
RAI 505 — 07.01-36	5	5
RAI 505 — 07.01-37	6	6
RAI 505 — 07.01-38	7	7
RAI 505 — 07.01-39	8	8
RAI 505 — 07.01-40	9	9
RAI 505 — 07.01-41	10	10
RAI 505 — 07.01-42	11	11
RAI 505 — 07.01-43	12	12
RAI 505 — 07.01-44	13	13
RAI 505 — 07.01-45	14	14
RAI 505 — 07.01-46	15	15
RAI 505 — 07.01-47	16	16
RAI 505 — 07.01-48	17	18
RAI 505 — 07.01-49	19	19
RAI 505 — 07.01-50	20	20
RAI 505 — 07.01-51	21	22
RAI 505 — 07.03-37	23	23
RAI 505 — 07.03-38	24	24
RAI 505 — 07.04-15	25	25
RAI 505 — 07.05-10	26	26
RAI 505 — 07.05-11	27	27
RAI 505 — 07.07-23	28	28
RAI 505 — 07.08-43	29	29
RAI 505 — 07.08-44	30	30
RAI 505 — 07.08-45	31	31
RAI 505 — 07.08-46	32	32
RAI 505 — 07.08-47	33	33
RAI 505 — 07.08-48	34	34
RAI 505 — 07.08-49	35	35
RAI 505 — 07.09-71	36	36
RAI 505 — 07.09-72	37	37

A complete answer is not provided for the 34 questions. The schedule for a technically correct and complete response to these questions is provided below.

Please note that the date for the response to Question 07.01-33 is a commitment date to provide a final schedule for the response in a follow-up letter.

Question #	Response Date
RAI 505 — 07.01-33	October 27, 2011
RAI 505 — 07.01-34	December 8, 2011
RAI 505 — 07.01-35	November 17, 2011
RAI 505 — 07.01-36	December 8, 2011
RAI 505 — 07.01-37	December 8, 2011
RAI 505 — 07.01-38	December 20, 2011
RAI 505 — 07.01-39	December 8, 2011
RAI 505 — 07.01-40	December 8, 2011
RAI 505 — 07.01-41	November 17, 2011
RAI 505 — 07.01-42	December 20, 2011
RAI 505 — 07.01-43	November 17, 2011
RAI 505 — 07.01-44	December 20, 2011
RAI 505 — 07.01-45	December 20, 2011
RAI 505 — 07.01-46	December 20, 2011
RAI 505 — 07.01-47	December 8, 2011
RAI 505 — 07.01-48	December 20, 2011
RAI 505 — 07.01-49	December 20, 2011
RAI 505 — 07.01-50	December 20, 2011
RAI 505 — 07.01-51	December 20, 2011
RAI 505 — 07.03-37	November 17, 2011
RAI 505 — 07.03-38	December 20, 2011
RAI 505 — 07.04-15	November 17, 2011
RAI 505 — 07.05-10	November 17, 2011
RAI 505 — 07.05-11	November 17, 2011
RAI 505 — 07.07-23	November 17, 2011
RAI 505 — 07.08-43	December 20, 2011
RAI 505 — 07.08-44	December 8, 2011
RAI 505 — 07.08-45	December 8, 2011
RAI 505 — 07.08-46	December 8, 2011
RAI 505 — 07.08-47	December 20, 2011
RAI 505 — 07.08-48	December 20, 2011
RAI 505 — 07.08-49	November 17, 2011
RAI 505 — 07.09-71	December 8, 2011
RAI 505 — 07.09-72	December 8, 2011

Sincerely,

Dennis Williford, P.E.
U.S. EPR Design Certification Licensing Manager
AREVA NP Inc.

7207 IBM Drive, Mail Code CLT 2B
Charlotte, NC 28262
Phone: 704-805-2223
Email: Dennis.Williford@areva.com

From: Tesfaye, Getachew [mailto:Getachew.Tesfaye@nrc.gov]
Sent: Tuesday, August 30, 2011 1:23 PM
To: ZZ-DL-A-USEPR-DL
Cc: Zhang, Deanna; Morton, Wendell; Spaulding, Deirdre; Mott, Kenneth; Truong, Tung; Zhao, Jack; Mills, Daniel; Jackson, Terry; Canova, Michael; Colaccino, Joseph; ArevaEPRDCPEm Resource
Subject: U.S. EPR Design Certification Application RAI No. 505 (5902,5735,5869,5754,5803,5950,5744), FSAR Ch. 7

Attached please find the subject requests for additional information (RAI). A draft of the RAI was provided to you on August 12, 2011, and discussed with your staff on August 22 and 25, 2011. No change is made to the draft RAI as a result of those discussions. The schedule we have established for review of your application assumes technically correct and complete responses within 30 days of receipt of RAIs. For any RAIs that cannot be answered within 30 days, it is expected that a date for receipt of this information will be provided to the staff within the 30 day period so that the staff can assess how this information will impact the published schedule.

Thanks,
Getachew Tesfaye
Sr. Project Manager
NRO/DNRL/NARP
(301) 415-3361

Hearing Identifier: AREVA_EPR_DC_RAIs
Email Number: 3647

Mail Envelope Properties (2FBE1051AEB2E748A0F98DF9EEE5A5D4A02B47)

Subject: Response to U.S. EPR Design Certification Application RAI No. 505 (5902,5735,5869,5754,5803,5950,5744), FSAR Ch. 7, Supplement 6
Sent Date: 12/15/2011 1:49:10 PM
Received Date: 12/15/2011 1:52:27 PM
From: WILLIFORD Dennis (AREVA)

Created By: Dennis.Williford@areva.com

Recipients:
"BENNETT Kathy (AREVA)" <Kathy.Bennett@areva.com>
Tracking Status: None
"DELANO Karen (AREVA)" <Karen.Delano@areva.com>
Tracking Status: None
"ROMINE Judy (AREVA)" <Judy.Romine@areva.com>
Tracking Status: None
"RYAN Tom (AREVA)" <Tom.Ryan@areva.com>
Tracking Status: None
"Tesfaye, Getachew" <Getachew.Tesfaye@nrc.gov>
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Priority: Standard
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Sensitivity: Normal
Expiration Date:
Recipients Received:

Response to

Request for Additional Information No. 505 (5902,5735,5869,5754,5803,5950,5744), Supplement 6

8/30/2011

U. S. EPR Standard Design Certification
AREVA NP Inc.
Docket No. 52-020
SRP Section: 07.01 - Instrumentation and Controls - Introduction
SRP Section: 07.03 - Engineered Safety Features Systems
SRP Section: 07.04 - Safe Shutdown Systems
SRP Section: 07.05 - Information Systems Important to Safety
SRP Section: 07.07 - Control Systems
SRP Section: 07.08 - Diverse Instrumentation and Control Systems
SRP Section: 07.09 - Data Communication Systems

Application Section: FSAR Chapter 7

QUESTIONS for Instrumentation, Controls and Electrical Engineering 1 (AP1000/EPR Projects) (ICE1)

Question 07.03-37:

OPEN ITEM

Provide clarification on various changes made to U.S. EPR FSAR, Tier 2, Section 7.3, under the response to RAI 442, Question 07.03-32.

The applicant provided Interim Revision 3 mark-ups of Tier 2, Section 7.3, in response to RAI 442, Question 07.03-32. After a review of the changes made to Table 7.3-1, the staff has three observations:

a. The Turbine Trip Function was deleted.

b. For the CVCS isolation for anti-dilution protective function, boron temperature was removed from the list of variables monitored for this function in Interim Revision 3 mark-ups of the U.S. EPR FSAR. Tier 2, Figure 7.3-22, that depicts this function, does not show boron temperature being deleted as a change for Interim Revision 3 mark-ups. Interim Revision 3 mark-up of Tier 2, Section 7.3.1.2.11, does not describe boron temperature as an input variable and does not show any revision concerning this deletion. Revision 2 of Tier 2, Section 7.3, shows boron temperature as an input variable on Figure 7.3-22. Table 7.3-1 also shows boron temperature as a monitored variable.

c. For MFWS isolation protective function, reactor trip (RT) breaker position was deleted. Also, steam generator (SG) isolation signal was not included. Tier 2, Figure 7.3-16, depicts the MFWS isolation function. RT initiation is shown as an input variable while SG isolation signal is not shown. Interim Revision 3 mark-up of Tier 2, Section 7.3.1.2.8, describes both the initiation of RT and SG isolation signal as initiating conditions for MFWS isolation.

The staff requests that applicant provide clarification on why these changes were made.

Response to Question 07.03-37:

In the Interim Revision 3 markups of U.S. EPR FSAR Tier 2, Section 7.3, in response to RAI 442, Question 07.03-32, the Turbine Trip function was removed from Table 7.3-1 because the RT breaker position measurements are no longer used to initiate a Turbine Trip (TT). The TT function is initiated when any RT function is initiated as described in U.S. EPR FSAR Tier 2, Section 7.3.1.2.17.

The Interim Revision 3 markups of U.S. EPR FSAR Tier 2, Section 7.3, in response to RAI 442, Question 07.03-32, removed the boron temperature measurement from U.S. EPR FSAR Tier 2, Figure 7.3-22 and Table 7.3-1. U.S. EPR FSAR Tier 2, Section 7.3.1.2.11 was revised to specify that the boron concentration measurement is provided by the boron concentration measurement system (BCMS). These revisions were made because the boron temperature measurement is received by the BCMS, where it is processed, along with the boron concentration, to provide the distributed control system with a temperature compensated boron concentration measurement. This is described in U.S. EPR FSAR Tier 2, Section 7.1.1.5.4 and Figure 7.1-16.

In the Interim Revision 3 markups of Tier 2, Section 7.3, in response to RAI 442, Question 07.03-32, the RT breaker position measurements were removed from Table 7.3-1 because the RT breaker position measurements are no longer used to initiate the main feedwater system (MFWS) isolation. MFWS isolation occurs on the initiation of an RT and on SG isolation. The initiation of an RT actuates an MFWS full-load isolation signal and also provides an SG Level > Max0p signal (shown on U.S. EPR FSAR Tier 2, Figure 7.3-16). The SG Level > Max0p signal initiates MFWS safety shutdown system (SSS) isolation signal (shown in U.S. EPR FSAR Tier 2, Figure 7.3-17). U.S. EPR FSAR Tier 2, Figure 7.3-18 and Figure 7.3-19, show the MFWS full-load isolation signal and MFWS SSS isolation signal in combination with the SG isolation signal in Functional OR gates to actuate MFWS isolation components.

FSAR Impact:

The U.S. EPR FSAR will not be changed as a result of this question.

Question 07.04-15:

OPEN ITEM

Clarify the display and control capability of the safety information and control system (SICS) in the remote shutdown station (RSS) and address inspection, tests, analyses, and acceptance criteria (ITAAC) for engineered safety feature (ESF) controls, including those associated with safety automation system (SAS).

10 CFR 52.47(a)(2) requires, in part, a description of structures, systems, and components sufficient to permit understanding of the system design. U.S. EPR Design Control Document, Tier 2, Section 7.4.1.3.4, Interim Revision 3 mark-ups, Page 7.4-7, states, in part:

> *"… the HMI [PICS and the SICS] workstation both in the MCR and RSS will continue to display …"*
>
> *"… The SICS and PICS provide the displays and controls in the RSS to allow the monitoring and control and control of the following safe shutdown …"*

Tier 2, Section 7.4.1.3.4, Interim Revision 3 mark-ups, Page 7.4-9, states "An indication on the PICS and SICS shows that RSS control has been established." During the review, the staff questioned whether SICS provides displays and the necessary manual controls in the RSS. Also, the staff questioned if any SAS manual controls were needed in the RSS. The staff did not identify any ITAAC in Tier 1, Section 2.4, addressing ESF manual actuations in the RSS. The applicant is requested to confirm the scope of displays and controls for SICS in the RSS and to provide ITAAC that verify the manual controls in RSS.

Response to Question 07.04-15:

Display Capability of SICS in RSS:

There are no indications in the RSS that are part of SICS. The indications needed for safe shutdown are available on PICS, including permissives status. Since there are no SICS indications in the RSS, there are no ITAAC associated with SICS indications.

Control Capability of SICS in RSS:

The SICS controls inventory in the RSS are the controls that are not available on PICS, and are needed to reach and maintain safe shutdown. The list of controls available on SICS in the RSS is listed in U.S. EPR FSAR Tier 2, Section 7.4.1.1. The other controls needed to reach and maintain safe shutdown are available from PICS. U.S. EPR FSAR Tier 2, Section 7.4.1.3.4 will be modified to clarify the scope of the RSS controls and indications.

An ITAAC that verifies the inventory of controls in the RSS on the SICS was provided as part of the Response to RAI 506 14.04.05-38.

No SAS controls are needed in the RSS to reach and maintain safe shutdown following evacuation of the main control room. All of the SICS controls located in the RSS are related to the protection system. No system level ESF actuations are needed in the RSS because the RSS is only provided for safe shutdown and not accident mitigation.

FSAR Impact:

U.S. EPR FSAR Tier 2, Section 7.4.1.3.4 will be revised as described in the response and indicated on the enclosed markup.

Question 07.05-11:

OPEN ITEM

Is a COL Information Item necessary for verification of the PAMS instrument list, and are there any site-specific PAMS instrumentation for the U.S. EPR?

10 CFR Part 50, Appendix A, General Design Criteria 13, "Instrumentation and Controls," requires, in part, that instrumentation be provided to monitor variables and systems over their anticipated ranges for normal operation, anticipated operational occurrences, and accident conditions. During the review of the U.S. EPR design certification and the Calvert Cliffs combined license (COL) application, the staff noted that the Calvert Cliffs COL application addressed a COL information item associated with updating the PAMS instrument list. Given the existence of ITAAC in Section 3.7 of the U.S. EPR FSAR, Tier 1, to verify the PAMS instrument list following completion of the emergency procedures, is there a need for a COL information item related to verification of the PAMS instrument list? Second, the staff did not see discussion in the U.S. EPR FSAR related to any site-specific PAMS instruments. For example, meteorological instruments and instruments associated with other site-specific structures, systems, and components may be PAMS instruments. The applicant is requested to address the need for a COL information item to address site-specific PAMS instruments.

Response to Question 07.05-11:

The inspections, tests, analyses and acceptance criteria (ITAAC) in U.S. EPR Tier 1, Section 3.7 will be revised in response to Question 7.5-10 of this RAI. This ITAAC item does not “verify the PAMS Instrument List” as suggested in the question. A combined license (COL) item is currently included to confirm that the procedures are consistent with the inventory list of PAM variables, upon completion of the emergency operating and abnormal operating procedures. This type of activity does not meet the criteria for inclusion in ITAAC, as described in U.S. EPR FSAR Tier 2, Section 14.3.

A new COL information item in U.S. EPR FSAR will be added to, U.S. EPR Tier 2, Section 7.5.2.2.1, to address site-specific PAMS variables.

FSAR Impact:

The U.S. EPR FSAR Tier 2, Sections 1.8 and 7.5.2.2.1 will be revised as described in the response and indicated on the enclosed markup.

Question 07.08-43:

OPEN ITEM

The staff requests the applicant to provide clear and unambiguous design commitment descriptions for (1) the DAS and PS credited human diversity and (2) credited SICS indications.

10 CFR 52.47(a)(2) requires that a description and analysis of the structures, systems, and components (SSCs) of the facility shall be sufficient to permit understanding of the system designs and their relationship to the safety evaluations. The information provided for the design basis items, taken alone and in combination, should have one and only one interpretation. The staff requests the applicant to clarify the following design descriptions:

a. Section 3.2.1 of Technical Report ANP-10304 provides a diversity design commitment between the PS TXS platform and the DAS platform that the design organization, management, designers, programmers, and testing engineers will be different. However, Section 4.2 of the same report states that it is likely that different design organizations will be responsible for the design of the two systems and that this will not be determined until the detailed design of these systems is in progress. These two design statements for the DAS and PS credited human diversity are conflicting. The applicant is requested to clarify the commitment for human diversity.

b. Table 2-1 of Technical Report ANP-10304 states that the SICS indicators can include programmable electronic I&C technology, which, according to Tier 2, Section 7.1, Interim Revision 3 mark-ups, can be TXS microprocessor-based. By contrast, Section 4.2 of Technical Report ANP-10304, SICS design diversity, states that the indications provided in SICS are performed by hardwired, analog components. The information provided for the design basis items, taken alone and in combination, should have one and only one interpretation. The staff request the applicant to provide clear design descriptions about the type of SICS indicators that are credited in the Technical Report ANP-10304.

Response to Question 07.08-43:

a) Technical Report ANP-10304 will be revised to clarify the commitment that different design organizations will be responsible for the design of the two systems.

b) Section 4.2 in Technical Report ANP-10304 will be revised as shown in the attached markups.

c) U.S. EPR FSAR Tier 2, Section 7.1 defines programmable electronic instrumentation and control (I&C) technology as: “I&C technology that is based on solid state components whose function is programmed via software.” While this can include microprocessors, the safety information and control system (SICS) indicators credited in the defense-in-depth analysis do not use Teleperm XS (TXS) microprocessor-based programmable electronics.

d) Section 4.2 in Technical Report ANP-10304 will be revised as shown in the attached markups.

FSAR Impact:

The U.S. EPR FSAR will not be changed as a result of this question.

Technical Report ANP-10304, Revision 4 will be revised as described in the response and indicated on the enclosed markup. ANP-10304, Revision 5 will be submitted by separate letter after completion of all the responses to RAI 505.

Question 07.08-45:

OPEN ITEM

The staff requests the applicant to provide clear and unambiguous design descriptions for the claimed PS subsystem diversity descriptions for all applicable design documents.

10CFR52.47(a)(2) requires that a description and analysis of the structures, systems, and components (SSCs) of the facility shall be sufficient to permit understanding of the system designs and their relationship to the safety evaluations. The staff reviewed the U.S. EPR design documents for PS subsystem diversity design. Technical Report ANP-10309, Revision 3, states in Section 1.0, last paragraph, that:

> *"The PS provides signal diversity, as described in Section 10.0, "Signal Diversity." The signal diversity design rules presented in Section 10 represent elements of diversity described in NUREG/CR-6303 (Reference 3). AREVA NP* **takes credit** *[emphasis added] for the signal diversity within the PS, as described in the U.S. EPR Diversity and Defense-in-Depth Assessment Technical Report, ANP-10304."*

However, Section 10.1 of Technical Report ANP-10309 states:

> *"Signal diversity, as applied to the PS, is the use of two diverse parameters to initiate RT to mitigate the effects of the same AOO or PA. This signal diversity* **is not credited** *[emphasis added] in the diversity and defense-in-depth plant response analysis to mitigate any AOO or PA."*

Furthermore, Section 4.2.4 of Technical Report ANP-10304 states:

> *"Each PS division is divided into two independent subsystems (i.e., A and B). Subsystem A in each division is redundant to Subsystem A of other divisions; the same is true of Subsystem B. The primary purpose of this arrangement* **is to provide** *[emphasis added] signal diversity for RT functions."*

In addition, it is not always stated within the design descriptions that the credited signal diversity is only applicable for RT functions. As stated in Section 2.2 of Technical Report ANP-10304:

> *"Each division of the PS contains two independent subsystems to support signal diversity."*

The information provided for the design basis items, taken alone and in combination, should have one and only one interpretation. The staff request the applicant to provide clear, consistent, and unambiguous design descriptions about the functions that PS subsystem diversity is credited for and specify when the PS subsystem design diversity is credited for all applicable design documents.

Response to Question 07.08-45:

The diversity and defense-in-depth analysis, as described in ANP-10304, "U.S. EPR Diversity and Defense-in-Depth Assessment," assumes that there is a complete failure of the PS. Therefore, signal diversity for RT functions implemented in the subsystems of the PS is not

credited to mitigate any events in the D3 plant response analysis. However, the signal diversity within the PS provides an added layer of protection in the overall U.S. EPR plant defense-in-depth strategy.

Section 1.0 in Technical Report ANP-10309P, and Technical Report ANP-10304, Section 2.2, will be revised as shown in the attached markups to provide clarification and consistent interpretation.

FSAR Impact:

The U.S. EPR FSAR will not be changed as a result of this question.

Technical Report Impact:

Technical Report ANP-10309P, Section 1.0, will be revised as described in the response and indicated on the enclosed markup.

Technical Report ANP-10304, Section 2.2, will be revised as described in the response and indicated on the enclosed markup.

Question 07.08-49:

OPEN ITEM

The staff request the applicant to identify or provide design descriptions that would define what the design characteristics are of the credited DAS “software structure” and to demonstrate the diversity achieved between the TXS software attributes and the credited software attributes of the DAS "software structure."

10CFR50.62(c)(1) and (c)(6) requires that ATWS equipment must be diverse from the reactor trip system. 10CFR52.47(a)(2) requires that a description and analysis of the structures, systems, and components (SSCs) of the facility shall be sufficient to permit understanding of the system designs and their relationship to the safety evaluations. The applicant states in Section 4.2 of Technical Report ANP-10304 that if the DAS uses programmable electronic technology that it will not be microprocessor based and that the *software structure* will be *fundamentally different*. The staff reviewed the U.S. EPR DAS design descriptions in the U.S. EPR, Tier 1 and 2, U.S. EPR FSAR, Interim Revision 3 mark-ups, and Technical Report ANP-10309, Revision 4, and could not identify design descriptions that would demonstrate the design characteristics and credited diversity attributes of the DAS possible implementation using "structured software." Therefore, the staff requests the applicant to provide this design information.

Response to Question 07.08-49:

The diverse actuation system (DAS) will not be microprocessor based programmable electronic technology. The following types of technology may be used:

- Non-microprocessor based programmable electronics – The two primary types of technologies in this category include programmable logic devicess and field-programmable gate arrays. These devices are programmed with firmware and do not contain application software and system software as they exist in microprocessors.

- Electronic technology – This technology consists of discrete electronics whose logic is determined by physically changing connections. No software exists.

- Electrical technology – This includes electrical components such as relays. No software exists.

As a result, the functioning logic will not be accomplished in a software based system, such as what is in a microprocessor. This provides a stronger case of “software diversity” because a potential common cause failure that could affect the application or system software of a microprocessor-based system would not affect the DAS. U.S. EPR FSAR Tier 2, Section 7.1.1.4.7 and Technical Report ANP-10304 will be modified to clarify the types of technology that may be used.

FSAR Impact:

U.S. EPR FSAR, Tier 2, Section 7.1.1.4.7 will be revised as described in the response and indicated on the enclosed markup.

Technical Report ANP-10304, Revision 4 will be revised as described in the response and indicated on the enclosed markup. ANP-10304, Revision 5 will be submitted by separate letter after completion of all the responses to RAI 505.

U.S. EPR Final Safety Analysis Report Markups

Table 1.8-2—U.S. EPR Combined License Information Items
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Item No.	Description	Section
6.4-3	A COL applicant that references the U.S. EPR design certification will evaluate the results of the toxic chemical accidents from Section 2.2.3, address their impact on control room habitability in accordance with RG 1.78, and if necessary, identify the types of sensors and automatic control functions required for control room operator protection.	6.4.1
6.4-4	A COL applicant that references the U.S. EPR design certification will confirm that the radiation exposure of main control room occupants resulting from a design basis accident at a nearby unit on a multi-unit site is bounded by the radiation exposure from the postulated design basis accidents analyzed for the U.S. EPR; or confirm that the limits of GDC-19 are met.	6.4.4
6.6-1	A COL applicant that references the U.S. EPR design certification will identify the implementation milestones for the site-specific ASME Section XI preservice and inservice inspection program for the Class 2 and Class 3 components, consistent with the requirements of 10 CFR 50.55a (g). The program will identify the applicable edition and addenda of the ASME Code Section XI, and will identify additional relief requests and alternatives to Code requirements.	6.6
7.1-1	A COL applicant that references the U.S. EPR design certification will confirm the inventory list of PAM variables in Table 7.5-1—Inventory of Post-Accident Monitoring Variables upon completion of the emergency operating and abnormal operating procedures prior to fuel loading.	7.5.2.2.1
7.1-2	A COL applicant that references the U.S. EPR design certification will, following selection of the actual plant operating instrumentation and calculation of the instrumentation uncertainties of the operating plant parameters, prior to fuel load, calculate the primary power calorimetric uncertainty. The calculations will be completed using an NRC acceptable method and confirm that the safety analysis primary power calorimetric uncertainty bounds the calculated values.	7.7.2.3.5
7.1-3	A COL applicant that references the U.S. EPR design certification will identify the need for any site-specific PAM variables.	7.5.2.2.1
8.1-1	A COL applicant that references the U.S. EPR design certification will provide site-specific information describing the interface between the offsite transmission system, and the nuclear unit, including switchyard interconnections.	8.1.1
8.1-2	A COL applicant that references the U.S. EPR design certification will identify site-specific loading differences that raise EDG or Class 1E battery loading, and demonstrate the electrical distribution system is adequately sized for the additional load.	8.1.3

RAI 505, Q 07.05-11

appropriate reviews, verification, tests, and approvals. Sufficient quality is achieved in the design of the DAS through the following measures:

- The DAS is designed, fabricated, erected, and tested under the quality assurance program described in ANP-10266A, Addendum A (Reference 42). This quality assurance program is consistent with the guidance of Generic Letter 85-06 (Reference 43).
- The design of the DAS is accomplished through a phased approach including the following (or equivalent) phases:
  - System requirements phase.
  - System design phase.
  - Software/hardware requirements phase.
  - Software/hardware design phase.
  - Software/hardware implementation phase.
  - Software/hardware validation phase.
  - System integration phase.
  - System validation phase.
- A criticality analysis is performed for the DAS software in accordance with accepted industrial practice.
- V&V of the DAS software is performed according to a V&V plan that is consistent with accepted industrial practice.
- DAS requirements are documented in a traceable form that is under configuration management.
- The DAS design is validated through acceptance test in the system validation (or equivalent) phase.

RAI 505, Q. 07.08-49

Diversity Requirements

The DAS is required to be ~~either an electrical, electronic, or programmable electronic I&C technology other than~~ non-microprocessor based technology. See ANP-10304 (Reference 8) for further information on defense-in-depth and diversity.

Data Communications

There are no data communications associated with the DAS.

- A single failure of a system, structure, or component required to bring the plant to safe shutdown (in the event of a fire, no additional single failure, unrelated to the damage caused by the fire, is considered).

- A sustained loss of either onsite or offsite AC power.

RAI 505, Q. 07.04-15

The RSS contains both the PICS and the SICS. The PICS provides most of the necessary controls for safe shutdown. The SICS controls are only those controls needed to achieve safe shutdown that are unavailable on the PICS. These SICS controls are listed in Section 7.4.1.1. The PICS provides all displays necessary to reach and maintain safe shutdown. The architecture of the SICS and PICS is described in Section 7.1. Communication equipment is described in Section 9.5.2.

The ~~SICS and PICS provide the~~ displays and controls in the RSS to allow the monitoring and control of the following safe shutdown functions during a postulated fire in the MCR or during an event that could cause the MCR to become uninhabitable, coupled with a single failure:

- Reactivity control.

- Reactor coolant makeup.

- Reactor coolant system pressure control.

- Decay heat removal.

- Control and monitoring of safety support systems for the above functions, as well as essential service water, component cooling water, and onsite power including the emergency diesel generators.

The physical layout of the RSS and equipment located in it is taken into consideration in the human factors engineering program described in Chapter 18.

In the event of a condition requiring MCR evacuation, operators will transfer control from the MCR to the RSS via the MCR-RSS transfer switches, which are located in the RSS. MCR actions required per procedures to transfer control to the RSS can be accomplished during a rapid evacuation of the MCR. Communications equipment is provided to support the transfer. If the MCR requires evacuation, the following actions are taken:

- Perform an RT (from the MCR if time allows, from the RSS if there is not enough time).

- Log out of the PICS workstations in the MCR (if time allows).

- Transition to the RSS.

- Actuate the MCR-RSS transfer switches, which performs the following actions:

RAI 505, Q. 07.05-11

- A gap evaluation was performed to confirm that critical safety functions and fission product barriers described in IEEE Std 497-2002 were adequately monitored by the list of instruments developed.

The list of PAM variables is provided in Table 7.5-1.

A COL applicant that references the U.S. EPR design certification will identify the need for site-specific PAM variables.

Confirmation of the PAM Variables

To meet the guidance of RG 1.97, Revision 4 and Reference 1, a systematic step-by-step review of the plant-specific EOPs for the U.S. EPR is required. See Section 13.5 for more information on U.S. EPR procedure development.

A COL applicant that references the U.S. EPR design certification will confirm the inventory list of PAM variables in Table 7.5-1 upon completion of the emergency operating and abnormal operating procedures prior to fuel loading.

The confirmation that the procedures are consistent with ~~of~~ the PAM variables list ~~by the COL Applicant~~ will be documented by the COL Applicant in a table format that includes the following:

- Variable name that indicates the variable function.
- Variable Type (A, B, C, D or E).
- Range.
- Safety classification (1E or non-1E).
- Environmental and Seismic Qualification.
- Minimum number of instruments required.
- Monitoring duration for the variable.

Criteria for Selection of Variable Types

In accordance with RG 1.97, Revision 4, and IEEE Std 497-2002, the PAM variables are selected and the variable types are determined according to its accident management function. These variables are the primary source of post-accident monitoring information. Five types of variables exist and the selection criteria are described as follows:

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MARKUPS

which these diverse initiation signals are combined with the automatic actuation logic in the diverse actuation system (DAS) is similar to the PS logic.

The SICS also contains qualified display system (QDS) video display units. These are provided, in addition to the required dedicated SICS indications, to provide trending and graphing capabilities of a limited number of plant parameters to improve operator situational awareness. The QDS displays receive input from the PS for display and do not have control capabilities.

The safety-related portions of the SICS are designed to the requirements of 10 CFR 50.55a(h) (Reference 1) The design of U.S. EPR I&C systems conforms to IEEE 603-1998 in lieu of IEEE 603-1991 based on an alternative request pursuant to 10 CFR 50.55a(a)(3)(i), (Reference 16).

2.2 *Automation Systems*

The PS is a safety-related integrated RT and ESF actuation system. The PS detects the conditions indicative of an AOO or PA and actuates the plant safety features to mitigate these events. This is accomplished primarily through the execution of automatic safety I&C actuation functions; specifically, RT and actuation of ESF systems. The PS has four redundant, independent divisions. Each division is located in a physically separated Safeguards Building. Each division of the PS contains two independent subsystems to support signal diversity for RT functions. The PS utilizes the TXS platform and is designed to the requirements of 10 CFR 50.55a(h) subject to the alternative request described in Section 2.1.

RAI 505, Q. 07.08-45

The safety automation system (SAS) is a safety-related system. The SAS processes automatic control functions, and manually initiated grouped control functions, to mitigate AOOs and PAs and to reach and maintain safe shutdown. The SAS has four independent divisions. Each division is located in a physically separated Safeguards Building. Additional SAS equipment is located in the two physically separated Emergency Diesel Generating Buildings and the four Essential Service Water Pump Structures. For maximum reliability, there are redundant controllers within each division of the SAS. The SAS utilizes the TXS platform and is designed to the requirements of 10 CFR 50.55a(h) subject to the alternative request described in Section 2.1.

The reactor control, surveillance, and limitation system (RCSL) performs core-related operational and limitation I&C functions. It is a redundant (master - hot standby) control system with physical separation of redundant equipment located in separate Safeguard Buildings. The RCSL utilizes the TXS platform and is a non-safety-related system.

The process automation system (PAS) executes the majority of plant control functions. Specifically, it performs operational and limitation I&C functions, except those performed by RCSL. The PAS is a non-safety-related system and is implemented with an industrial control platform other than TXS.

RAI 505, Q. 07.08-49

The DAS is a non-safety related system that executes those functions needed to mitigate an AOO or PA concurrent with a CCF of the PS. The DAS will not be microprocessor-based programmable electronic technology. The following types of technology may be used:

- Non-microprocessor-based Programmable Electronics - The two primary types of technologies in this category include programmable logic devices and field-programmable gate arrays. These devices are programmed with firmware and do not contain application software and system software as they exist in microprocessors.
- Electronic Technology - This technology consists of discrete electronics whose logic is determined by physically changing connections. No software exists.
- Electrical Technology - This includes electrical components such as relays. No software exists.~~The DAS executes those functions needed to mitigate an AOO or PA concurrent with a CCF of the PS. The DAS is a non-safety-related system and will be implemented with either electrical, electronic, or programmable electronic technology that is not microprocessor based.~~

The priority and actuator control system (PACS) is a safety-related system. It performs the following functions: priority control, drive actuation, drive monitoring, and essential component protection. Each safety-related actuator is associated with one PACS communication-priority pair (CoPP). Each CoPP consists of two modules: a safety-related priority logic module, and a non-safety-related communication module. The priority module is subject to 100 percent combinatorial testing and is therefore not subject to an SWCCF. The priority module is designed to the requirements of 10 CFR50.55a(h) subject to the alternative request described in Section 2.1.

been made to credit this type of different logic as a “less effective”, but still relevant, characteristic of software diversity.

Safety Information and Control System:

RAI 505, Q. 07.08-43

The SICS exhibits the following diversity attributes relative to the PS:

- Design diversity–The control functions and most of the indications provided in SICS are performed by dedicated, hardwired I&C components. Some of the indications use non-TXS microprocessor-based programmable electronics. All of the indications credited in the D3 analysis bypass the PS components. The PS uses TXS microprocessor-based programmable electronic technology to implement all of its functions.~~The control functions and indications provided in SICS are performed by hardwired, analog components. The PS uses micro-processor based programmable electronic technology to implement its functions.~~ Including different technology in the design is a “more effective” characteristic of design diversity.
- Equipment diversity–At a minimum, the SICS equipment will be of fundamentally different design than the PS equipment. Section 3.2.1 identifies this commitment. The use of fundamentally different designs is a “more effective” characteristic of equipment diversity.
- Functional diversity–The SICS fulfills a fundamentally different purpose, and performs different types of functions, than the PS. The SICS is a human-machine interface system that allows the operator to monitor and control plant operation. The PS performs automatic actuation functions specifically designed to respond to AOOs or PAs. Different purpose and function is a “more effective” characteristic of functional diversity.
- Human diversity–At a minimum, different engineers will be responsible for the design of the SICS and PS. It is likely that different design organizations will be responsible for the design of the equipment of the two systems, which is the most effective characteristic of human diversity. This will not be determined until the detailed design of these systems is in progress. As a conservative measure, only the use of different engineers is credited in human diversity, which constitutes a “less effective”, but still relevant, characteristic of human diversity.

- Software diversity–Because of its different purpose and function, the SICS uses completely different algorithms and logics in the components that are microprocessor-based. In addition, the SICS functions that are software based use non-TXS microprocessors. All of the indications credited in the D3 analysis bypass the PS components. ~~The SICS uses a hardwired, analog I&C platform to implement a human-machine interface. There is no software running in the SICS, with exception of the QDS, which is for display purposes only and is not credited in the D3 analysis.~~ This constitutes a "more effective" characteristic of software diversity.

Process Information and Control System:

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The PICS exhibits the following diversity attributes relative to the PS:

- Design diversity–The PICS architecture is shown in U.S. EPR FSAR Tier 2, Section 7.1, and it is clearly different from the PS architecture. Different architecture is a "less effective", but still relevant, characteristic of design diversity.
- Equipment diversity–At a minimum, the PICS equipment will be of fundamentally different design than the PS equipment. Section 3.2.1 identifies this commitment. The use of fundamentally different designs is a "more effective" characteristic of equipment diversity.
- Functional diversity–The PICS fulfills a fundamentally different purpose, and performs different types of functions, than the PS. The PICS is a human-machine interface system that allows the operator to monitor and control plant operation. The PS performs automatic actuation functions specifically designed to respond to AOOs or PAs. Two systems with different purposes and functions require significantly different application software structures. This greatly reduces the risk of the same latent software defect existing in the two systems. Different purpose and function is a "more effective" characteristic of functional diversity.
- Human diversity–At a minimum, different engineers will be responsible for the design of the PICS and PS. It is likely that different design organizations will be responsible for the software design of the two systems (the most effective characteristic of human diversity. This will not be determined until the detailed software design of these systems is in progress. As a conservative measure,, only the use of different engineers is

- Equipment diversity–At a minimum, the DAS equipment will be a fundamentally different design than the PS equipment. Section 3.2.1 identifies this commitment. The use of a fundamentally different design is a “more effective” characteristic of equipment diversity.
- Functional diversity–The DAS is designed with the intent of allowing the PS to actuate before the DAS, in response to a DBE. This results in different setpoint parameters and delay times for the DAS functions, compared to the PS. Different response timescale is a “less effective”, but still relevant, characteristic of functional diversity.

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- Human diversity–Different design organizations (i.e., different management, engineers, designers, and programmers) will be responsible for the design of the two systems. This establishes a "more effective" case of human diversity.~~At a minimum, different engineers will be responsible for the design of the DAS and PS. It is likely that different design organizations will be responsible for the design of the two systems (the most effective characteristic of human diversity. This will not be determined until the detailed design of these systems is in progress. To be conservative, only the use of different engineers is credited, which constitutes a “less effective”, but still relevant characteristic of human diversity.~~
- Software diversity–The DAS is implemented with non-microprocessor based technology. As such, there is no system software or application software as found in microprocessor based systems. This constitutes a "more effective" characteristic for overall platform diversity.~~If the DAS uses programmable electronic technology, it will not be microprocessor based, so the software structure will be fundamentally different. This establishes a “more effective” case of software diversity.~~

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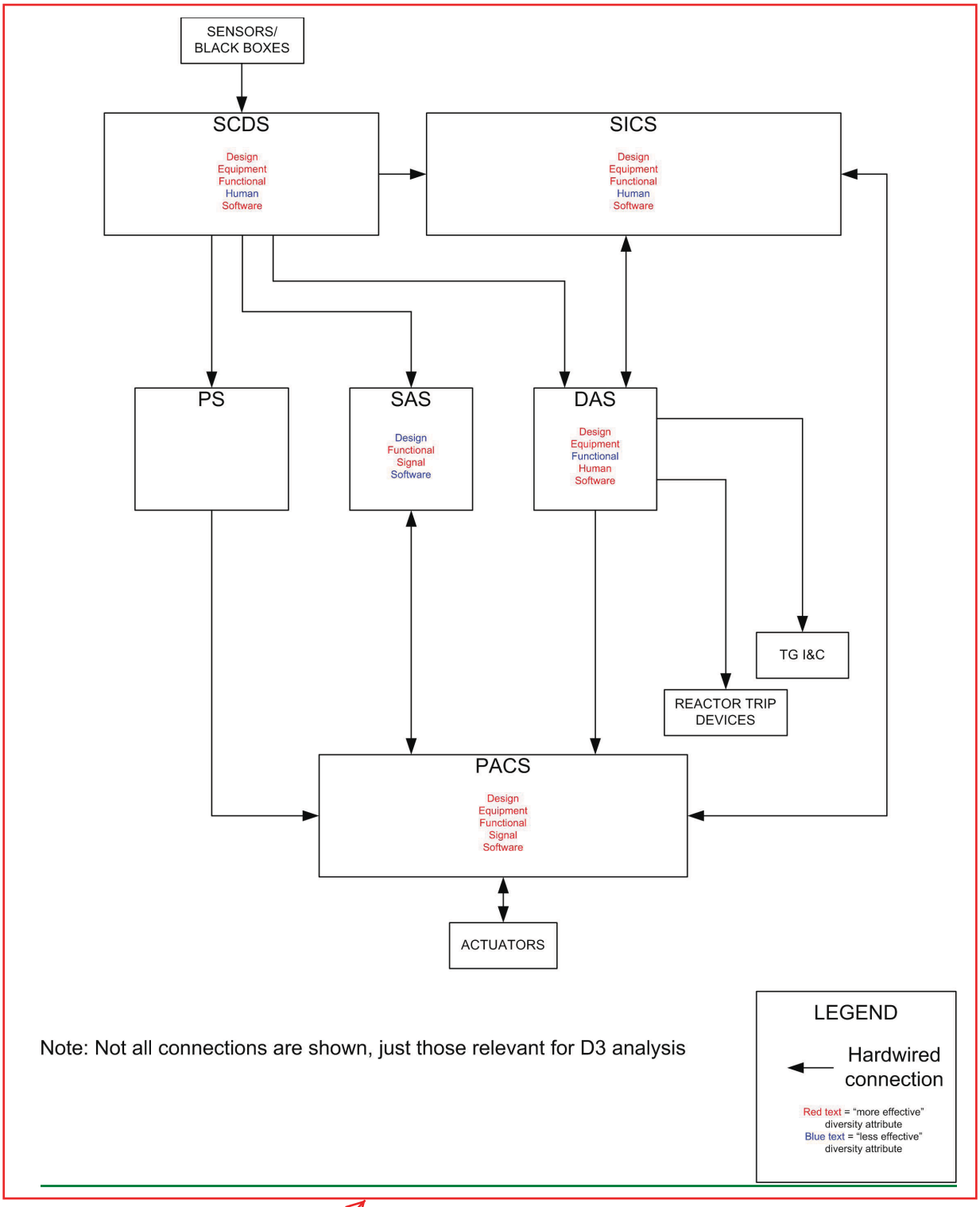
Priority and Actuator Control System:

The PACS exhibits the following diversity attributes relative to the PS:

- Design diversity–The equipment used in the priority module of the PACS is PLD based PE, which is different from the microprocessor based PE in the PS. This constitutes a different approach within a technology, as listed in Guideline 2. Additionally, the PACS architecture is shown in U.S. EPR FSAR Tier 2, Section 7.1, and it is clearly different from the PS architecture. Most significantly, a standalone portion of the PACS is dedicated to each safety-related plant actuator, while the PS uses its whole architecture

Figure 4-2—Block Diagram with Diversity Attributes



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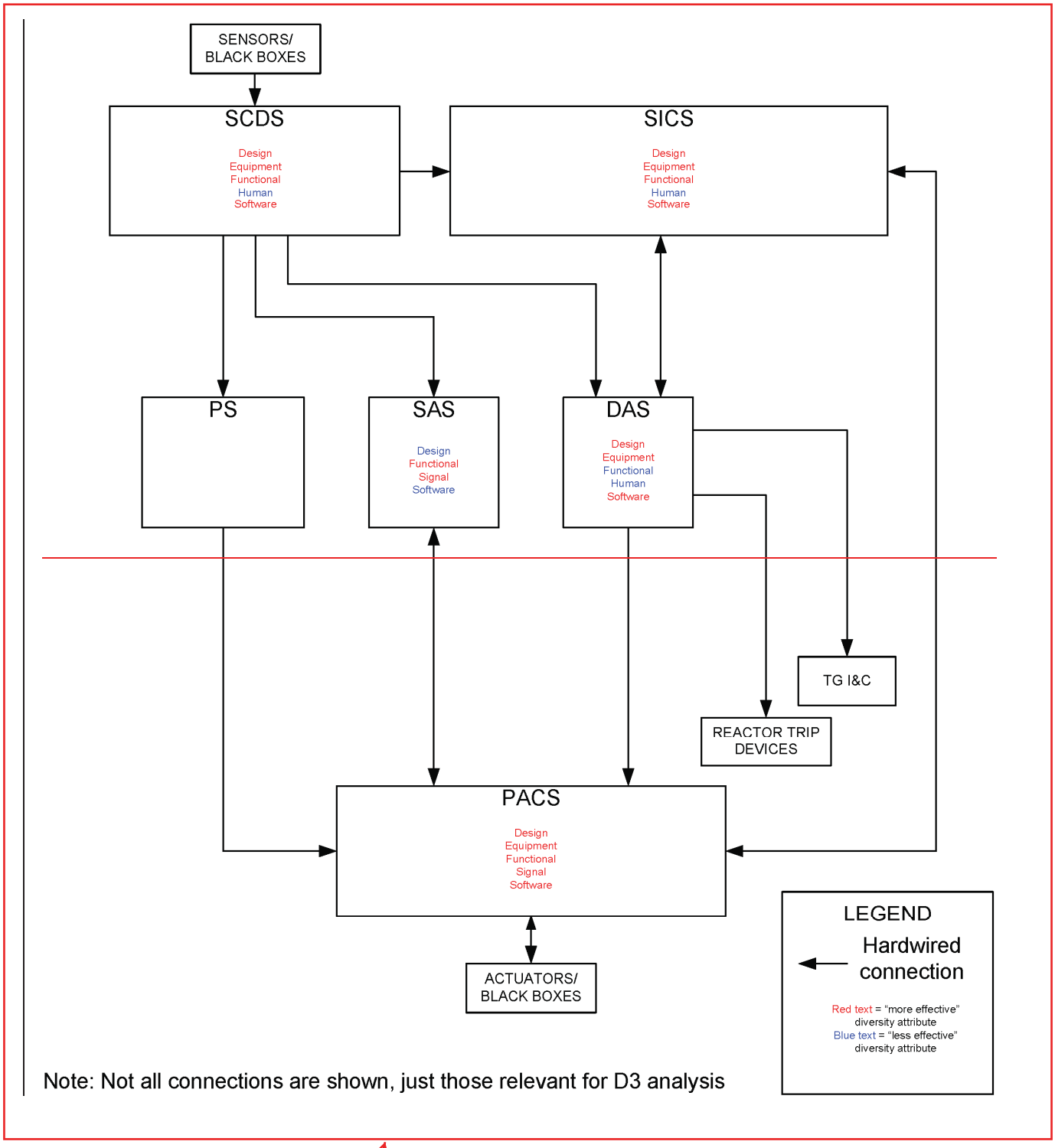

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U.S. EPR Protection System

Technical Report ANP-10309P

MARKUPS

1.0 INTRODUCTION

This technical report describes the design of the U.S. EPR™ protection system (PS), which includes the PS architecture and the typical implementation of functionality within this architecture, and is provided to support the design certification application for the U.S. EPR. Generic terms for the PS equipment are used (e.g., function processor, communication module, input module). Table 1-1Table 1-1 lists the generic equipment references used in correlation with the equivalent specific equipment that was audited as part of the NRC review of the TXS topical report (References 23 and 24).

The PS is a reactor protection system (RPS) and an engineered safety features actuation system (ESFAS) that is implemented using TELEPERM XS (TXS) technology. The TXS platform, described in Siemens Topical Report EMF-2110 (Reference 24), has been approved by the U.S. Nuclear Regulatory Commission (NRC) for use in safety-related instrumentation and control (I&C) applications (Reference 23). The PS detects plant conditions that indicate the occurrence of an anticipated operational occurrence (AOO) and postulated accident (PA) and initiates the plant safety features required to mitigate the AOO and PA. These actions are accomplished through automatic actuation of reactor trips (RT) and engineered safety features (ESF) systems.

The PS uses state-of-the-art TXS hardware and software, adheres to the approved TXS system design principles (both hardware and software), and meets applicable regulatory requirements and industry standards.

The PS provides signal diversity for reactor trip functions, as described in Section 10.0, "Signal Diversity." The signal diversity design rules presented in Section 10 represent elements of diversity described in NUREG/CR-6303 (Reference 3). AREVA NP takes credit for the signal diversity within the PS, as The diversity attributes of the PS are described in the U.S. EPR Diversity and Defense-in-Depth Assessment Technical Report, ANP-10304 (Reference 30).

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